Supporting Information

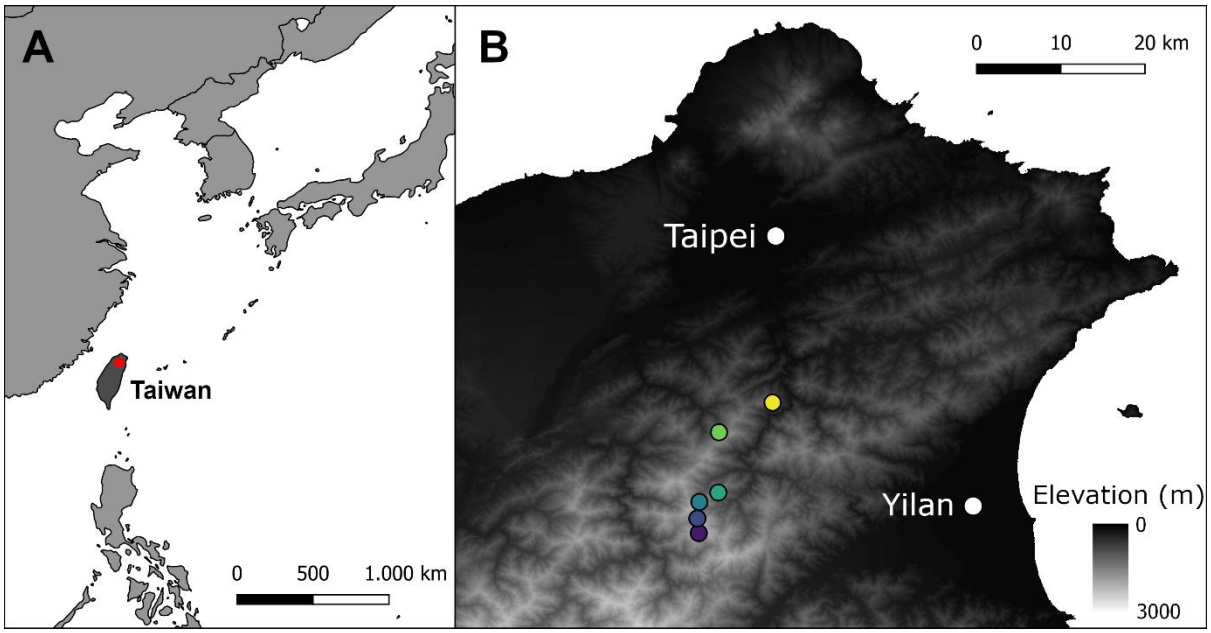

Figure S1. Location of the six elevation zones at which vegetation plots were established in northern Taiwan.

Table S2. Full species list. Species code provided for each terrestrial and epiphytic fern and lycophyte species. The column 'traits' indicates for which species functional traits were measured. [a] = no leaf chlorophyll content measurement using SPAD possible.

code	species	traits	code	species	traits
Terrestrial species					
1	*Acystopteris taiwaniana*	×	39	*Dryopteris polita*	
2	*Acystopteris tenuisecta*		40	*Dryopteris subexaltata*	
3	*Alsophila podophylla*	×	41	*Dryopteris subtriangularis*	×
4	*Alsophila spinulosa*		42	*Dryopteris wuzhaohongii*	×
5	*Arachniodes amabilis* var. *amabilis*	×	43	*Histiopteris incisa*	×
6	*Arachniodes festina*	×	44	*Huperzia serrata*	×
7	*Arachniodes pseudoaristata*	×	45	*Hymenasplenium adiantifrons*	×
8	*Asplenium normale* var. *normale*	×	46	*Leptogramma tottoides*	
9	*Athyrium arisanense*	×	47	*Lindsaea bonii*	×
10	*Athyrium delavayi* var. *delavayi*		48	*Lindsaea chienii*	×
11	*Athyrium iseanum* var. *angustisectum*		49	*Lycopodiella cernua*	
12	*Athyrium nakanoi*	×	50	*Metathelypteris gracilescens*	×
13	*Athyrium opacum*		51	*Metathelypteris laxa*	
14	*Blechnopsis orientalis*		52	*Metathelypteris uraiensis*	×
15	*Cheiropleuria integrifolia*		53	*Microlepia hookeriana*	×
16	*Coniogramme intermedia*		54	*Microlepia obtusiloba*	
17	*Coryphopteris angulariloba*		55	*Monachosorum henryi*	×
18	*Coryphopteris castanea*	×	56	*Nephrolepis cordifolia*	
19	*Dennstaedtia scabra*	×	57	*Odontosoria chinensis*	
20	*Deparia formosana*	×	58	*Plagiogyria adnata*	×
21	*Dicranopteris tetraphylla*		59	*Plagiogyria euphlebia*	×
22	*Diplazium dilatatum*	×	60	*Plagiogyria falcata*	×
23	*Diplazium doederleinii*	×	61	*Plagiogyria glauca*	×
24	*Diplazium donianum* var. *donianum*	×	62	*Plagiogyria stenoptera*	×
25	*Diplazium kawakamii* var. *kawakamii*	×	63	*Polystichum hancockii*	×
26	*Diplazium mettenianum*	×	64	*Polystichum integripinnum*	×
27	*Diplazium okinawaense*		65	*Polystichum parvipinnulum*	×
28	*Diplazium petrii*	×	66	*Pronephrium gymnopteridifrons*	×
29	*Diplazium pullingeri*	×	67	*Pteris bella*	×
30	*Diplazium sp.*		68	*Pteris tokioi*	×
31	*Diplazium virescens* var. *virescens*		69	*Pteris wallichiana*	
32	*Diplopterygium glaucum*	×	70	*Selaginella delicatula*	
33	*Dryopteris formosana*	×	71	*Selaginella doederleinii* subsp. *doederleinii*	
34	*Dryopteris hasseltii*	×	72	*Selaginella labordei*	
35	*Dryopteris hendersonii*	×	73	*Selaginella remotifolia*	
36	*Dryopteris lepidopoda*		74	*Stegnogramma griffithii*	×
37	*Dryopteris melanocarpa*	×	75	*Stegnogramma wilfordii*	×
38	*Dryopteris paleolata*	×	76	*Woodwardia unigemmata*	

code	species	traits	code	species	traits
Epiphytic species			98	*Lemmaphyllum rostratum*	×
77	*Abrodictyum obscurum*		99	*Lepidomicrosorium ningpoense*	×
78	*Arthromeris lehmannii*	×	100	*Lepisorus kawakamii*	×
79	*Asplenium antiquum*	×	101	*Lepisorus monilisorus*	×
80	*Asplenium nidus*	×	102	*Lepisorus obscurevenulosus*	×
81	*Asplenium wilfordii* var. *wilfordii*	×	103	*Lepisorus suboligolepidus*	×
82	*Crepidomanes minutum* subsp. *minutum*		104	*Loxogramme remotefrondigera*	×
83	*Davallia clarkei*	×	105	*Loxogramme salicifolia*	×
84	*Davallia trichomanoides*	×	106	*Micropolypodium okuboi*	×[a]
85	*Drynaria coronans*		107	*Monachosorum ma×imowiczii*	
86	*Elaphoglossum yoshinagae*	×	108	*Phlegmariurus cryptomerinus*	
87	*Goniophlebium amoenum* var. *arisanense*	×	109	*Phlegmariurus fargesii*	
88	*Goniophlebium mengtzeense*	×	110	*Phlegmariurus fordii*	
89	*Goniophlebium raishaense*		111	*Prosaptia formosana*	×
90	*Haplopteris flexuosa*	×	112	*Pyrrosia lingua*	×
91	*Hymenophyllum badium*	×	113	*Pyrrosia polydactylos*	×
92	*Hymenophyllum nitidulum*	×[a]	114	*Pyrrosia sheareri*	×
93	*Hymenophyllum okadae*	×	115	*Selaginella involvens*	
94	*Hymenophyllum oligosorum*	×	116	*Selliguea echinospora*	×
95	*Hymenophyllum paniculiflorum*	×[a]	117	*Selliguea engleri*	×
96	*Hymenophyllum polyanthos*	×	118	*Vandenboschia auriculata*	×
97	*Lemmaphyllum microphyllum*	×	119	*Vandenboschia kalamocarpa*	×[a]

Appendix S3. Extended trait measurement protocol.

Leaf thickness

Before trait measurements, stipes were removed for all the selected leaf samples. Leaf thickness (Lth, mm) was measured with a 1 µm resolution digital thickness gauge (DML3034, Digital Micrometers Ltd., UK). Leaf thickness was measured four times, at the upper left, upper right, lower left and lower right of the leaf (i.e. lamina), and averaged for each leaf. For simple laminas, the four measurement points were positioned at an equal distance from the midrib and the leaf margin (Fig S3.1, S3.2a). For ferns with compound laminas, the four measurement points were positioned in the middle of the pinnae, pinnules and pinnulets for single, double and triple-compound leaves, respectively, at an equal distance from the costa and the margin (Fig. S3.1, S3.2). Care was taken to avoid obvious veins and sori. When this proved difficult, part the lamina was cut, to ease leaf thickness measurement. Note that any cut off segments were carefully preserved for leaf area measurement (see further).

Area-based leaf chlorophyll content

Area-based chlorophyll content (Chl) was measured using a SPAD-502 chlorophyll meter (Konica Minolta, Japan). For each leaf, we performed one to twenty measurements on each side (left and right) of the lamina. For compound lamina with many pinnae, chlorophyll was measured every two or three pinnae. The number of measurements depended on the size of the lamina and the number of the pinnae (Fig. S3.3).

Leaf area

Leaf area (cm^2) was measured on each rehydrated leaf using a scanner (Perfection V370 PHOTO & Perfection V600 PHOTO, EPSON, Japan) and the image J software (Rueden et al. 2017). Before scanning, laminas were dissected to remove the free axes and prevent overlapping segment. Simple, palmatifid, pinnatifid, pinnatisect and bipinnatifid laminas were scanned directly. When lobes or pinnae overlapped, we cut along the rachis to separate them (Fig S3.4). For pinnate and pinnate-pinnatifid laminas, we first removed the full rachis and scanned the pinnae separately (Fig S3.4). For bipinnate and bipinnate-pinnatifid, tripinnate and higher-order compound laminas, the rachis and costas were first removed, before scanning the pinnules separately (Fig S3.4).

For bipinnate, bipinnatifid, tripinnate or more divided ferns with very fine segments, only a subset of all pinnae of the lamina were dissected (one every two, three or four pinnae pairs) as described earlier for measuring SLA, LDMC, and EWT (see further) to save time. All remaining pinnae of the lamina were only dissected by cutting the costa to prevent overlapping of the pinnules, and were then scanned for calculating leaf area.

Specific leaf area, leaf dry matter content and equivalent water thickness

Right after scanning, laminas (or the dissected pinnae or pinnules) were weighed using a 0.1 mg precision balance (Adventurer AR2140, OHAUS Corp. USA or XS 225A-SCS, Precisa, Switzerland) to obtain leaf fresh weight (g). All lamina, pinnae and pinnule parts were then transferred to one labelled paper bag per original leaf and oven dried at 70°C for at least 72 hours. After drying, dry weight (mg) was measured with the precision balance. Specific leaf area (SLA, mm^2/mg) was then calculated by dividing the one-sided leaf area by the leaf dry weight. Leaf dry matter content (LDMC, mg/g) was calculated as the leaf dry weight divided by the leaf fresh weight. Equivalent water thickness (EWT, mg/mm^2), which quantifies area-based water content was calculated as (leaf fresh weight – leaf dry weight)/ leaf area.

Leaf nitrogen content and leaf $^{13}C/^{12}C$ and $^{15}N/^{14}N$ stable isotope ratios.

After measuring leaf dry weights, one to four dried leaf samples of each species were selected to quantify leaf nitrogen content (leaf N, mg/g), leaf $^{13}C/^{12}C$ stable isotope ratio ($\delta^{13}C$, ‰) and leaf $^{15}N/^{14}N$ stable isotope ratio ($\delta^{15}N$, ‰). These leaves were selected based on the following criteria: 1) Preferably select a leaf from an individual with sporophylls; 2) select the leaves with the highest dry weight; 3) select leaves from plots closest to the mountain ridge (to minimize potential effects of plot aspect); 4) if, for a given individual, both fertile and sterile leaves are available, both are selected; 5) if the species occurred across several elevation zones, leaves were chosen to reflect its full elevation range. The selected samples were then grinded into a fine powder with the help of scissors, a mortar and a pestle. 2.000 ± 0.100 mg of the leaf powder was then weighted and placed into a tin capsule. Leaf N was measured on the tin capsules with a FlashEA 1112 series elemental analyzer (Thermo Fisher Scientific, Italy), while $\delta^{13}C$ and $\delta^{15}N$ were subsequently measured on the same sample with a Delta V Advantage isotope ratio mass spectrometer (Finnigan Mat, Germany), using Peedee belemnite (PDB) and atmospheric nitrogen as global standards for $\delta^{13}C$ and $\delta^{15}N$, respectively.

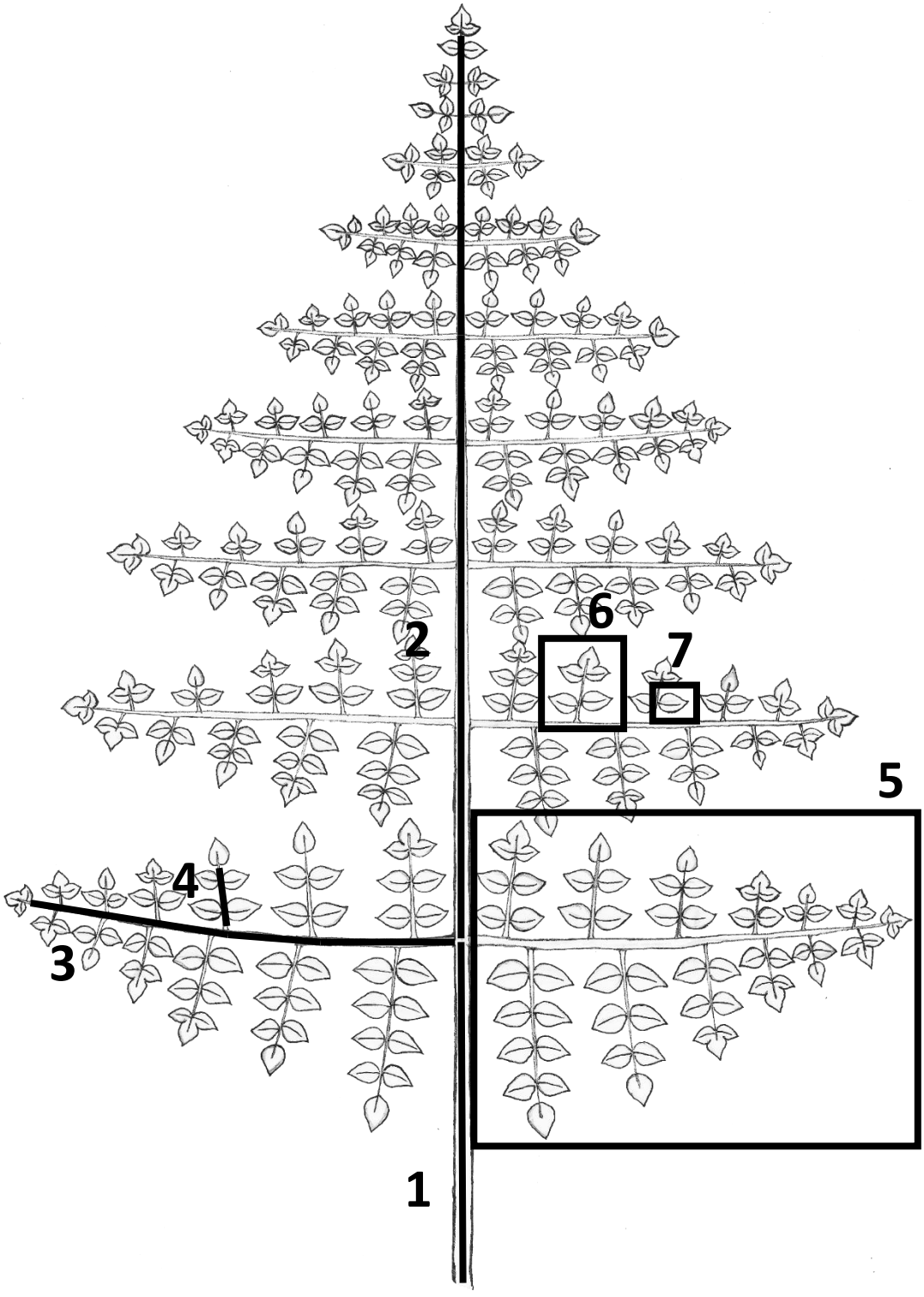

Figure S3.1. Terminology associated with fern leaf morphology. Axes terminology: 1. stipe, 2. rachis, 3. costa, 4. costule. Lamina structure terminology: 5. pinna, 6. pinnule, 7. pinnulet.

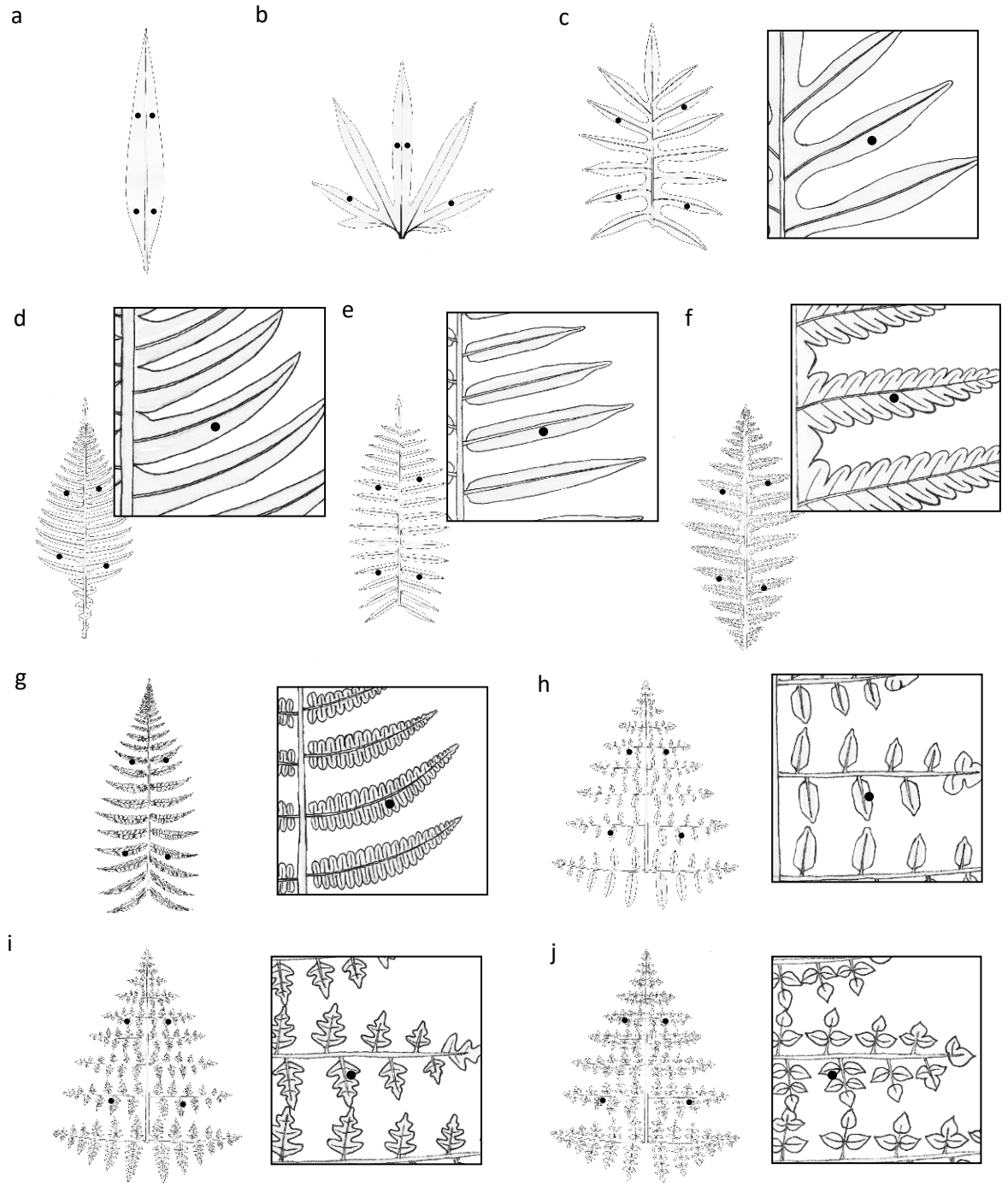

Figure S3.2. The positions for measuring leaf thickness for a) simple, b) palmatifid, c) pinnatisect, d) pinnatifid, e) pinnate, f) bipinnatifid, g) pinnate-pinnatifid, h) bipinnate, i) bipinnate-pinnatifid, and j) tripinnate laminae.

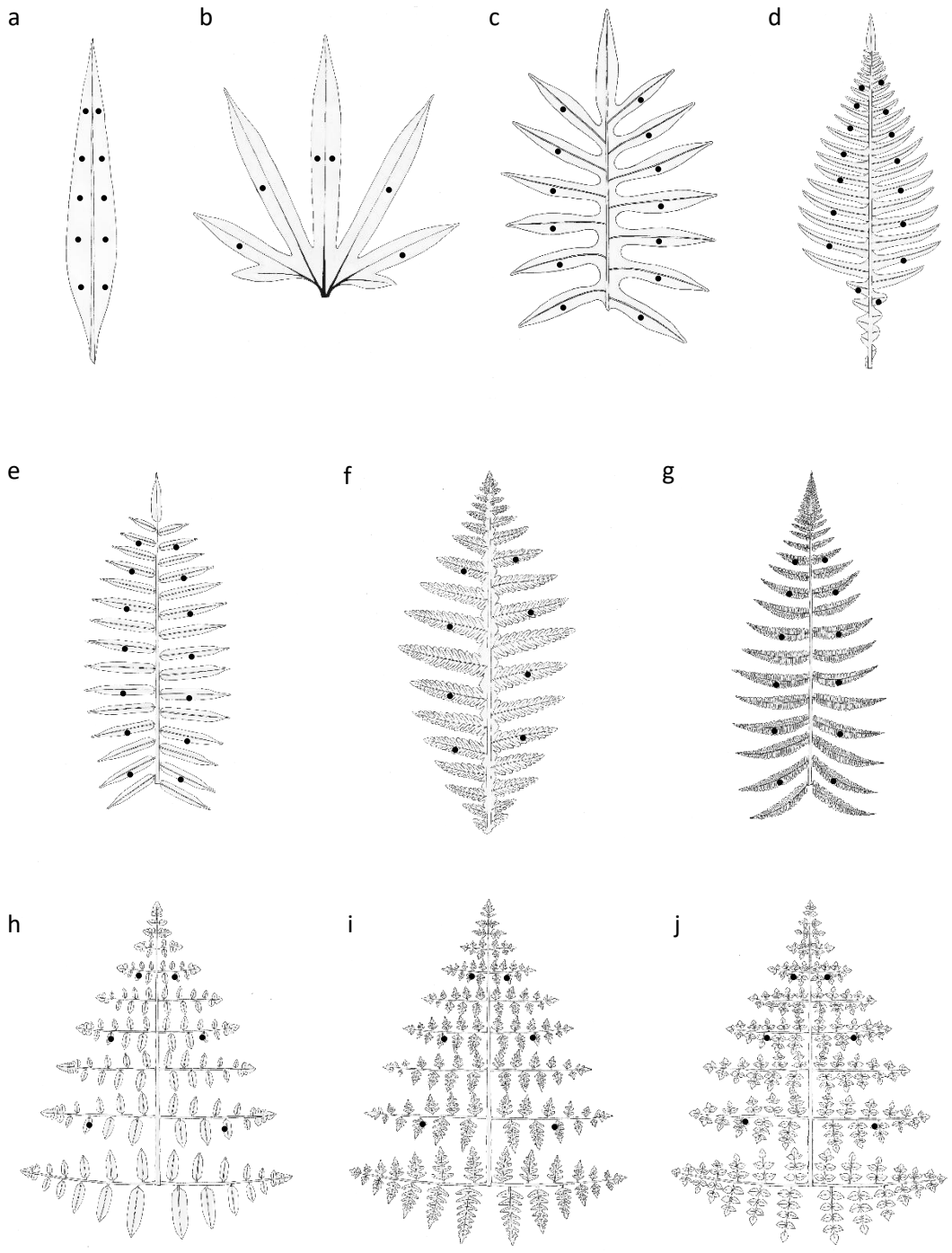

Figure S3.3. The positions for measuring leaf chlorophyll content for a) simple, b) palmatifid, c) pinnatisect, d) pinnatifid, e) pinnate, f) bipinnatifid, g) pinnate-pinnatifid, h) bipinnate, i) bipinnate-pinnatifid and j) tripinnate laminae.

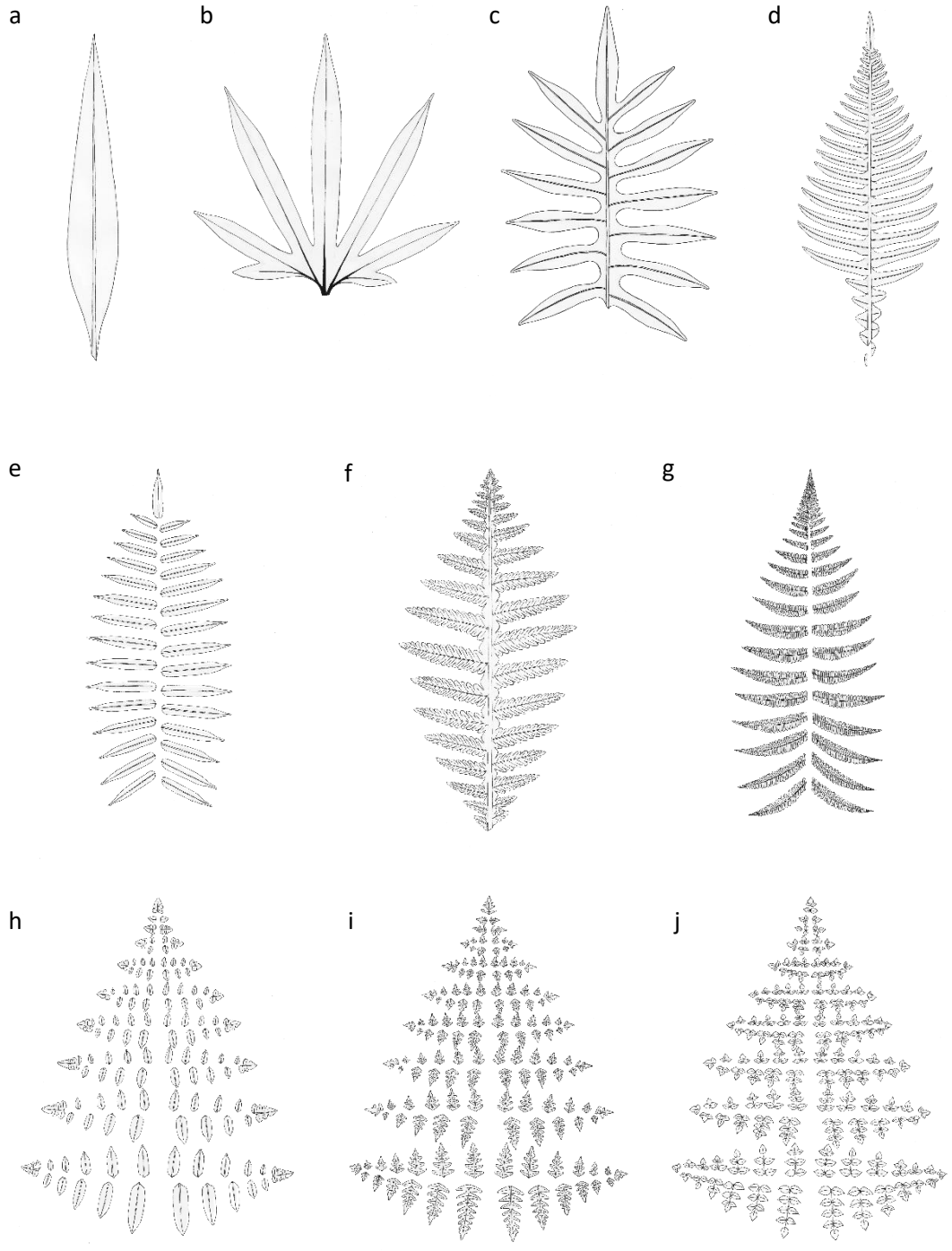

Figure S3.4. Procedure of leaf area measurement of a) simple, b) palmatifid, c) pinnatisect, d) pinnatifid, e) pinnate, f) bipinnatifid, g) pinnate-pinnatifid, h) bipinnate, i) bipinnate-pinnatifid and j) tripinnate laminae.

Table S4. Trait loadings and cumulative variation for the first three principal component axes (PC) for the three species × trait ordinations, one for all species combined, one only for epiphytic species and one for terrestrial species. Main contributors to each ordination axis (with absolute value of loading higher than 0.30) in bold. $\delta^{13}C$ = the leaf $^{13}C/^{12}C$ stable isotope ratio, $\delta^{15}N$ = the leaf $^{15}N/^{14}N$ stable isotope ratio, EWT = equivalent water thickness. ^{log} = log transformed.

	all species			epiphytic species			terrestrial species		
	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3
SLA	**0.46**	0.05	**-0.32**	**0.45**	0.02	-0.02	**0.51**	-0.09	-0.21
LDMC	0.17	**0.52**	**0.48**	**0.39**	**0.35**	0.21	-0.17	**0.60**	0.02
leaf area^{log}	0.18	**-0.51**	**0.31**	0.01	**-0.61**	**0.32**	-0.14	0.03	**-0.65**
leaf thickness	**-0.48**	-0.14	-0.21	**-0.46**	0.01	-0.13	**-0.36**	**-0.42**	0.13
leaf chlorophyll	-0.28	**-0.31**	**0.40**	**-0.34**	-0.03	0.04	**-0.48**	0.02	-0.01
EWT	**-0.48**	-0.11	-0.24	**-0.47**	-0.06	-0.08	-0.28	**-0.54**	0.13
$\delta^{13}C$	-0.21	0.16	**0.35**	-0.06	-0.22	**0.79**	-0.23	0.02	**-0.49**
$\delta^{15}N$	0.17	**-0.42**	**0.36**	0.11	**-0.53**	**-0.40**	**-0.36**	0.10	-0.29
leaf N	**0.34**	**-0.37**	-0.25	0.30	**-0.42**	-0.22	0.27	**-0.38**	**-0.41**
Cumul. variation (%)	39.9	61.3	75.2	44.9	63.7	76.2	37.2	61.2	75.8

Table S5. Trait loadings and cumulative variation for the first three principal component axes (PC) for the three plot × community mean (CM) trait ordinations, one for all species combined, one only for epiphytic species and one for terrestrial species. Main contributors to each ordination axis (with absolute value of loading higher than 0.30) in bold. $\delta^{13}C$ = the leaf $^{13}C/^{12}C$ stable isotope ratio, $\delta^{15}N$ = the leaf $^{15}N/^{14}N$ stable isotope ratio, EWT = equivalent water thickness. ^{log} = log transformed.

	all species			epiphytic species			terrestrial species		
	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3
CM SLA	0.28	**0.38**	**0.52**	**0.42**	0.12	-0.01	**0.48**	0.13	0.12
CM LDMC	-0.10	**0.55**	**-0.54**	**0.45**	0.02	0.23	**-0.34**	**0.44**	-0.06
CM leaf area^{log}	**0.40**	-0.20	-0.10	-0.28	**0.38**	**0.33**	-0.14	-0.19	**0.83**
CM leaf thickness	**-0.34**	**-0.37**	0.22	**-0.38**	**-0.33**	-0.16	0.02	**-0.59**	-0.25
CM leaf chlorophyll	0.25	**-0.47**	-0.28	**-0.38**	0.25	-0.16	**-0.45**	-0.12	0.09
CM EWT	**-0.37**	**-0.33**	0.16	**-0.39**	**-0.32**	-0.13	-0.08	**-0.61**	-0.01
CM $\delta^{13}C$	**-0.38**	-0.01	-0.28	-0.10	**-0.41**	**0.81**	**-0.31**	0.13	-0.03
CM $\delta^{15}N$	**0.35**	-0.21	**-0.41**	-0.29	**0.32**	**0.31**	**-0.46**	0.02	0.16
CM leaf N	**0.41**	-0.07	0.19	-0.10	**0.55**	0.09	**0.34**	0.05	**0.45**
Cumul. variation (%)	58.9	84.4	93.4	50.8	78.1	86.8	44.0	71.8	83.6

Table S6. Results of tests for differences in trait values between epiphytic and terrestrial species at the species-level (Mann-Whitney U test) and the community (CM)-level (Wilcoxon signed-rank test). Test-statistics (W/V) and p-value (after FDR correction) provided. Significant results in bold. ^{log} = logarithmic transformation.

	species		CM	
	W	p	V	p
SLA	**446**	**<0.001**	**179**	**<0.001**
LDMC	936	0.308	**1400**	**<0.001**
leaf area^{log}	**335**	**<0.001**	**0**	**<0.001**
leaf thickness	1036	0.052	**1690**	**<0.001**
leaf chlorophyll	684	0.717	**79**	**<0.001**
EWT	**1068**	**0.026**	**1752**	**<0.001**
$\delta^{13}C$	**1254**	**<0.001**	**1731**	**<0.001**
$\delta^{15}N$	**320**	**<0.001**	**0**	**<0.001**
leaf N	**154**	**<0.001**	**0**	**<0.001**

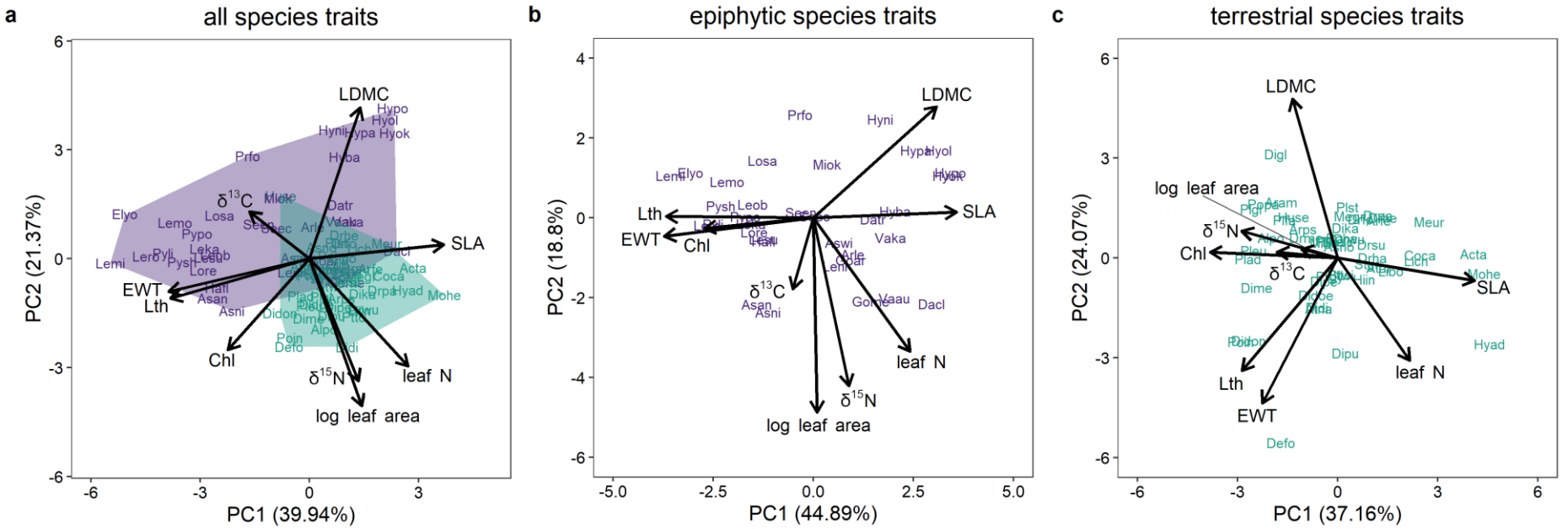

Figure S7. Biplots for the performed principal component analyses on A. the full species × trait matrix, B. the epiphytic species × trait matrix, C. the terrestrial species × trait matrix. Species visualized as abbreviations (first two letters of genus + first two letters of species, see Appendix S2 for full species names), plots visualized as points, traits visualized as vectors. Light green = terrestrial species, dark purple = epiphytic species. Chl = leaf chlorophyll content, $\delta^{13}C$ = the leaf $^{13}C/^{12}C$ stable isotope ratio, $\delta^{15}N$ = the leaf $^{15}N/^{14}N$ stable isotope ratio, EWT = equivalent water thickness.

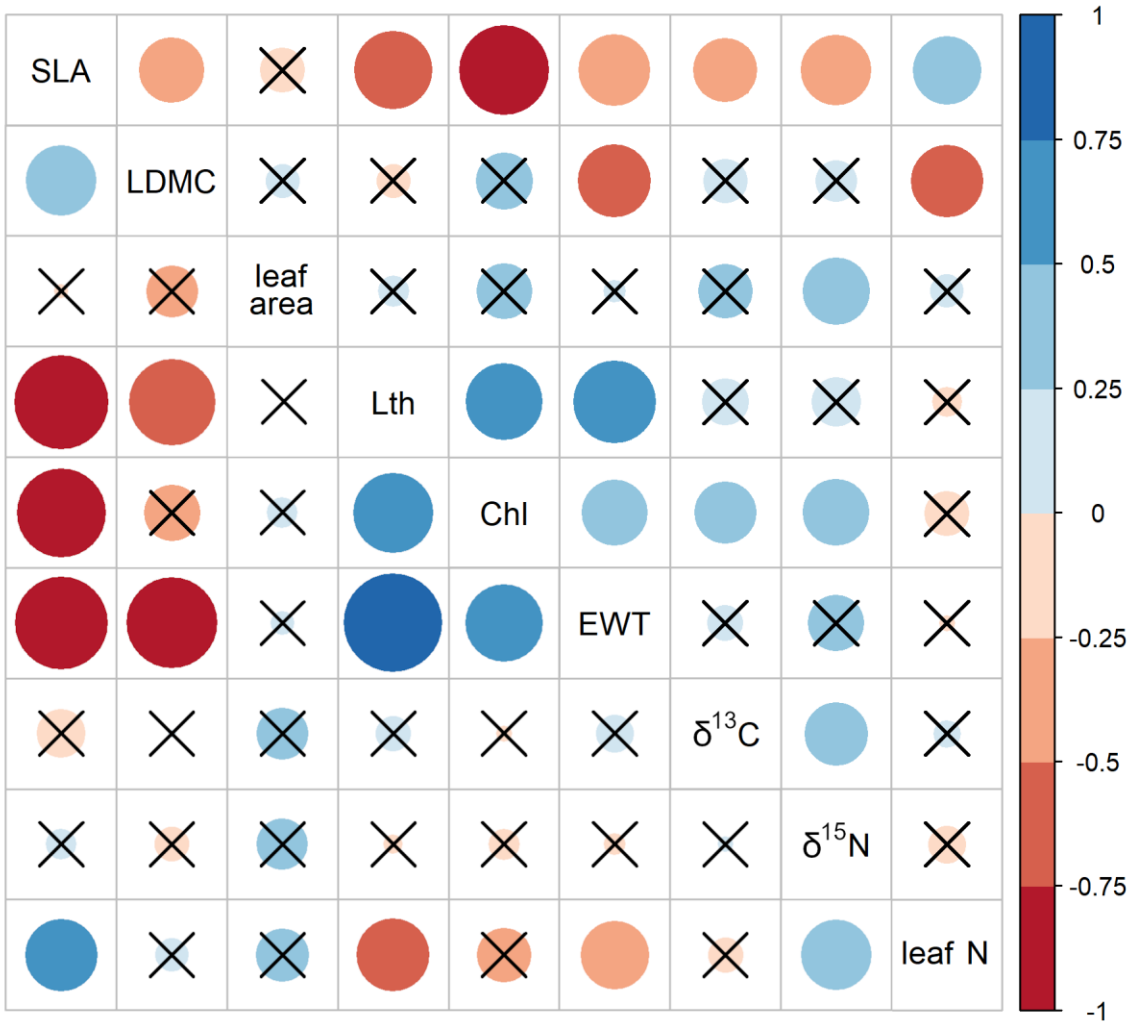

Figure S8. Pairwise Spearman rank correlations between all measured traits at the species level. Top triangle for terrestrial species, bottom triangle for epiphytic species. Colours and size relate to the strength of correlation (ρ). Non-significant correlations crossed out. Chl = leaf chlorophyll content, $\delta^{13}C$ = the leaf $^{13}C/^{12}C$ stable isotope ratio, $\delta^{15}N$ = the leaf $^{15}N/^{14}N$ stable isotope ratio, EWT = equivalent water thickness, Lth = leaf thickness.

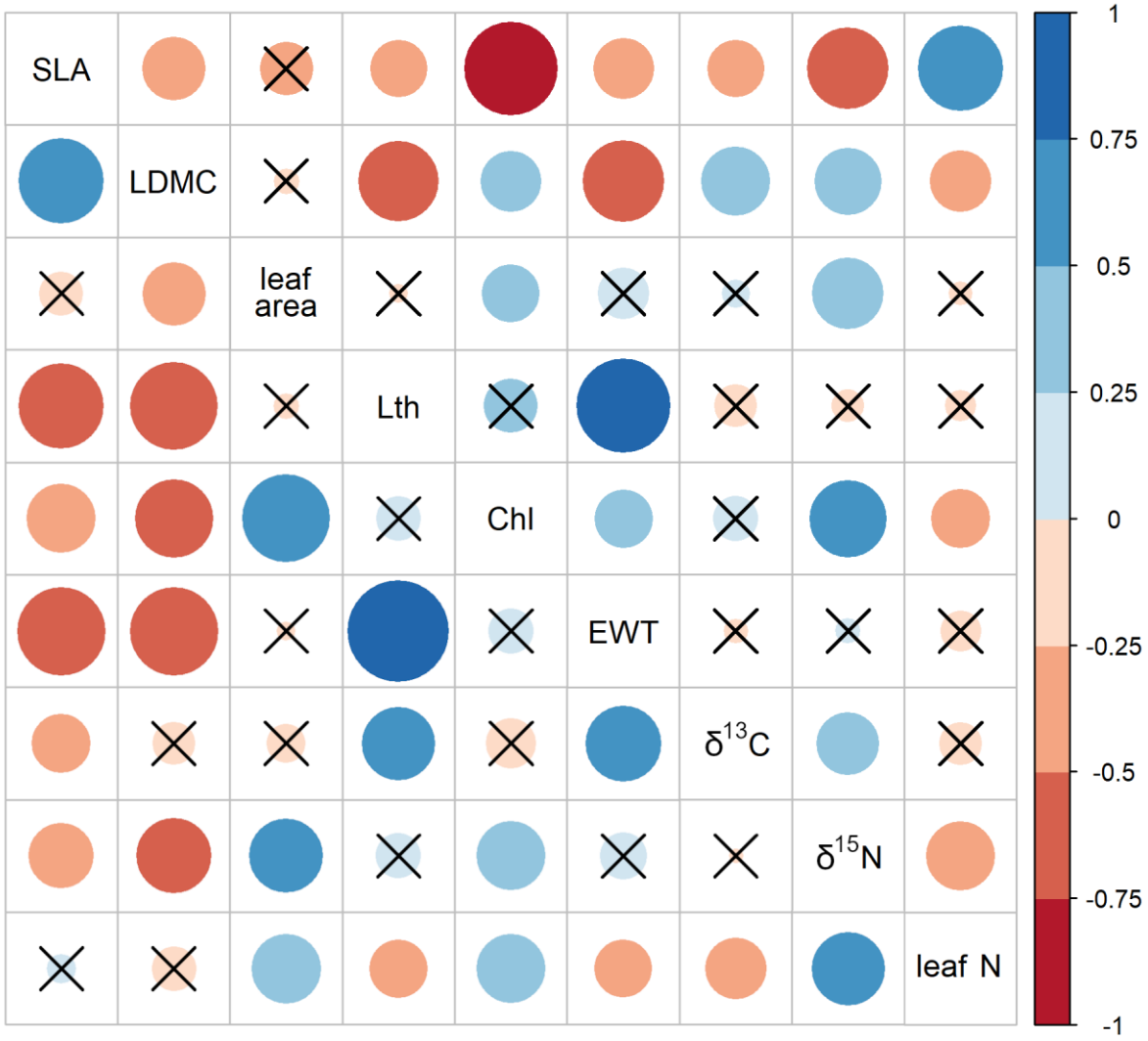

Figure S9. Pairwise Spearman rank correlations between all measured CM traits at the community level. Top triangle for terrestrial species, bottom triangle for epiphytic species. Colours relate to the strength of correlation (ρ). Non-significant correlations crossed out. Chl = leaf chlorophyll content, $\delta^{13}C$ = the leaf $^{13}C/^{12}C$ stable isotope ratio, $\delta^{15}N$ = the leaf $^{15}N/^{14}N$ stable isotope ratio, EWT = equivalent water thickness, Lth = leaf thickness.

Table S10. Pairwise Spearman rank correlation of community mean (CM) trait values between the epiphytic and terrestrial species dataset. ρ statistic and p value (after FDR correction) given. Significant results in bold. $\delta^{13}C$ = the leaf $^{13}C/^{12}C$ stable isotope ratio, $\delta^{15}N$ = the leaf $^{15}N/^{14}N$ stable isotope ratio, EWT = equivalent water thickness. a = logarithmic transformation for terrestrial species, b = logarithmic transformation for epiphytic species.

	ρ	p
SLA	0.12	0.440
LDMC	**0.27**	**0.050**
leaf area[ab]	-0.17	0.239
leaf thickness	**0.53**	**<0.001**
leaf chlorophyll content	0.11	0.448
EWT	**0.50**	**<0.001**
$\delta^{13}C$	**-0.38**	**0.005**
$\delta^{15}N$[a]	-0.06	0.685
leaf N	0.16	0.295